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Evaluation of Flight Control[R] to reduce blackbird damage to newly planted rice in Louisiana

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Abstract

Blackbirds cause extensive damage to newly planted and ripening rice. To date there is not a registered bird repellent for reducing this damage. We evaluated Flight Control[R], a 50% anthraquinone product, as a potential repellent to blackbirds in cage and field tests in Louisiana. In one- and no-choice cage tests, brown-headed cowbird and red-winged blackbird consumption of 2% Flight Control[R] treated rice seed was significantly reduced. In a subsequent field test, 2% Flight Control[R] was effective in reducing blackbird damage ($P = 0.001$) to newly planted rice seed. Chemical residues at 7 days post-planting averaged 0.66% anthraquinone. Further field testing is warranted. Published by Elsevier Science Ltd.

1. Introduction

Several species of blackbirds, particularly red-winged blackbirds (*Agelaius phoeniceus*), common grackles (*Quiscalus quiscula*) and brown-headed cowbirds (*Molothrus ater*) cause extensive damage to newly planted and ripening rice. Losses to rice growers have been estimated at US $11.5 million (Besser, 1985). In Texas, blackbird damage to newly seeded rice is estimated at $4.2 million (Decker and Avery, 1990). Damage is not uniformly distributed, but is localized and proportional to the size of nearby bird roosts. In Louisiana, blackbird damage to newly planted rice can be locally severe (Wilson, 1985). Some growers report 100% loss and replanting is required.

Several techniques are available to rice growers for alleviating blackbird damage, such as habitat manipulation, mechanical and pyrotechnic devices, and shooting (Dolbeer et al., 1994). However, each of these techniques has limitations because of cost, logistics or effectiveness. These limitations have stimulated efforts to develop an effective, economical, and environmentally safe chemical repellent (Cummings et al., 1992, 1994). One such chemical is anthraquinone which was first patented in 1944 as a bird repellent (US Patent #2,339,335). Use rates for seeds of cereal, vegetable and legume crops were about one pound of 25% anthraquinone per 500 lb of seed (Spencer, 1982). However, anthraquinone was never registered as a bird repellent in the United States. Recently, Environmental Biocontrol, International (EBI), 3521 Silverside Rd., Suite I-L, Wilmington, DE, USA 19810 developed a new anthraquinone formulation. Flight Control[R] is a 50% anthraquinone product that has shown promise as a bird repellent (Avery et al., 1998a, b; York et al., 1999). In our study we evaluated the repellency of Flight Control[R] to blackbirds in cage and field trials in Louisiana, USA.

2. Methods

2.1. Test chemical and formulation

Six kilograms of rice seed was treated with 2% Flight Control[R] for use in cage feeding tests. This concentration was derived from range finding tests using red-winged blackbirds (Avery et al., 1998a, b). A 20 ml sample of Flight Control[R] and a 20 g sample of 2% Flight Control[R] treated rice seed were collected for chemical analyses. Purity of the technical material was verified by EBI.

2.2. Cage tests

To simulate target birds feeding on rice seed treated with 2% Flight Control[R], male red-winged blackbirds and

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brown-headed cowbirds were captured, weighed and placed into 1.5×2.5×2 m test pens by species. Each group was of similar weight and had free access to rice seed and water. We followed criteria outlined by the Animal Welfare Act and the National Wildlife Research Center Animal Care and Use Committee during this study. After 3 days of acclimation, rice seed was removed at 1630 h. The following morning (0600 h), we initiated a one-choice test by presenting each group of 10 male red-winged blackbirds and 15 male brown-headed cowbirds with 2 plastic pans, one containing 500 g of 2% Flight Control^R treated rice seed and the other containing 500 g of untreated rice seed. The position of the treated and untreated feed were alternated daily. Pans were large enough to prevent any spillage caused by birds feeding. At 1630 h each day, consumption was adjusted for moisture and recorded by weighing the remaining rice seed. The test was conducted for 3 days.

In the no-choice test, the same procedures were followed except only 10 male red-winged blackbirds of similar weight were used to evaluate 2% Flight Control^R. Birds were presented with 2% Flight Control^R treated rice seed for 3 days followed by untreated rice seed on day 4.

Mean consumption per bird was calculated by dividing the amount of rice seed consumed by the total number of test birds. Percent reduction for 1-choice tests was calculated by subtracting the amount of treated rice seed consumed from untreated rice seed consumed and dividing that figure by the total untreated rice seed consumed.

2.3. *Field test*

We divided the field test into 3 phases. Phase 1 evaluated blackbird damage to rice seed soaked in a 1.3% Flight Control^R solution; Phase 2 evaluated blackbird damage to rice seed surface coated with 2% Flight Control^R; and Phase 3 evaluated blackbird damage to rice seed soaked in water and then surface coated with 2% Flight Control^R. Blackbird damage equates to the percent of seed loss.

We conducted the field test near Forked Island and Gueydan, Vermilion Parish, Louisiana during February and March. Test sites were within 10 km of major blackbird roosts in areas of historically high bird damage. Sites ranged from 1 to 2 ha, and were plowed, leveled, generally void of vegetation.

In Phase 1 and 2, we selected 6 of 15 potential sites that met our criteria that field use was > 2500 blackbirds and untreated rice seed was consumed daily. On each site, we established four 10 × 90 m lanes that were spaced about 20 m apart. To establish blackbird feeding activity, untreated rice seed was broadcast on all lanes for 4 days. Following this pretreatment period, two lanes in each field were randomly selected to receive respective treatments, while remaining lanes continued to receive untreated rice seed at the same rates as corresponding treatments.

Phase 1 treatment consisted of rice seed soaked in a 1.3% Flight Control^R solution containing 0.2% Exhalt^R sticker. The Exhalt^R sticker is used to adhere and encapsulate Flight Control^R to the rice seed and prevent degradation of the compound. After 24 h, rice seed was removed from the solution, pre-germinated for 24 h, and then broadcast with ground equipment on test site 1 at 18 kg/lane and at 27 kg/lane on test site 2. The remaining 2 lanes received untreated rice seed at the same rates.

Phase 2 treatment consisted of rice seed surface coated with 2% Flight Control^R (g/g) and 0.3% Exhalt^R sticker (g/g). Treated rice seed was prepared by placing rice seed in a mixer and spraying the rice with the appropriate application rate for 4 min as the mixer turned. Treated rice seed was poured into a bag and stored for 24 h before broadcasting on test site 3 at 22.5 kg/lane, on test site 4 at 35 kg/lane and on test site 5 at 45 kg/lane using methods described in Phase 1. The remaining lanes received untreated rice seeded at the same rates.

At the start of the pre-treatment period and continuing through the post-treatment period, we observed each site daily for 1 h in the morning after blackbirds arrived at the site. The number of blackbirds on each lane and the percent of the lane occupied were estimated and recorded. The starting time and location for bird observations was the same throughout the test at each site.

To determine daily consumption of rice seed by blackbirds we established 10 permanent sampling plots, 30×30 cm, along the center-line of each lane at each site. Plots were placed systematically at 9 m intervals along the lane beginning with a random starting point between 1 and 9 m. Each plot was manipulated to contained 25 rice seeds which visually matched the surrounding density of broadcast rice seed. Plots were assessed daily until all rice seed was consumed or blackbirds abandoned the field.

In Phases 1 and 2, mean consumption of rice seed and percent of lane occupied by blackbirds for each field were compared using a paired T-test (SAS/STAT Release 6.12 Copyright 1996).

In Phase 3, 5 fields of 2 ha were tested and bird control was not implemented. Three fields were randomly selected to receive treated rice seed and 2 received untreated rice seed. Fields were planted using normal water planting practices: plowed, leveled, flooded, planted and drained. Rice seed was soaked for 36 h, treated with 2% Flight Control^R (g/g) and 0.4% Exhalt^R sticker (g/g), pre-germinated for 48 h then aerially applied to rice fields at a rate of 136 kg/ha.

Bird observations were started the day following planting and conducted daily for 1 h after birds arrived at the field. The number of blackbirds by species in each test field and adjacent fields were recorded. The starting time and location for bird observations at each field was the same throughout the test.

We assessed each field for bird damage on days 1, 3, 5 and 7 after rice seed application. Five permanent sampling plots, 30 × 30 cm, were established along each of 4 transects at equal intervals. Each plot was assessed using a square template divided into 36 squares, 5×5 cm. The template was placed over each plot and the number of squares containing rice seed were recorded. In addition, five enclosures were paired with sampling plots from 2 of the 4 transects. Enclosures were assessed at the conclusion of the test to determine the expected number of grids containing rice seed.

We used SAS PROC MIXED (SAS/STAT Release 6.12 Copyright 1996) for analyzing mixed linear models with multiple sources of variation and the Satterthwaite option for generating error terms and degrees of freedom. We tested the null hypotheses of equal treatment effects among test fields.

2.4. Chemical residues

Rice seed treated with Flight Control[R] in Phase 1 was analyzed for residues just prior to planting. No residue analysis of treated seed was conducted in Phase 2. In Phase 3, rice seed from two test fields treated with Flight Control[R] was analyzed for residues at planting, and at 1, 3, 5, and 7 days post-planting using reversed-phase high performance liquid chromatography with ultra-violet detection.

3. Results

3.1. Chemical residues

Flight Control[R] residues on rice seed in Phase 1 was < 0.13% active ingredient (a.i.) at planting. Flight Control[R] residues (a.i.) from two test fields in Phase 3 averaged 0.88% at planting, 0.73% on day 1, 0.52% on day 3, 0.75% on day 5 and 0.66% on day 7.

3.2. Cage tests

In one-choice tests, brown-headed cowbird and red-winged blackbird consumption of 2% Flight Control[R] treated rice seed was reduced 81% and 92% on day 1, 90% and 98% on day 2 and 94% and 99% on day 3, respectively (Figs. 1 and 2). In no-choice tests, red-winged blackbird consumption of 2% Flight Control[R] treated rice on day 1 was 59% lower than normal daily intake for red-winged blackbirds, and decreased to about zero on days 2 and 3 (Fig. 3). On day 4, when untreated rice seed was introduced, consumption of untreated rice seed exceeded normal daily food intake for redwings by 63% (Fig. 3).

3.3. Field test

In Phase 1, the Flight Control[R] concentration of 0.13% a.i. did not meet the desired concentration of 1.0% a.i. At this concentration Flight Control[R] showed no repellency.

In Phase 2, blackbirds consumed significantly ($P = 0.01$) more rice seed from untreated seeded lanes (82%) than from lanes seeded with rice seed surface coated with 2% Flight Control[R] (11%). Also, blackbird use of untreated seeded lanes was significantly greater than treated lanes ($P = 0.06$).

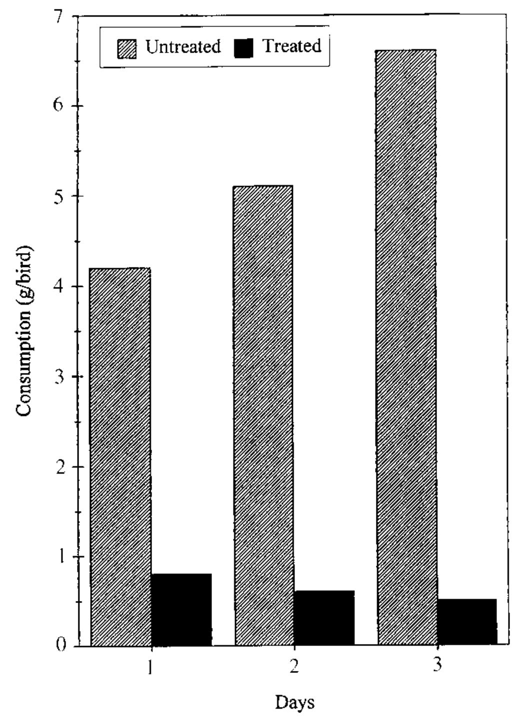

Fig. 1. Brown-headed cowbird consumption of 2% Flight Control[R] treated rice seed in a 1-choice test.

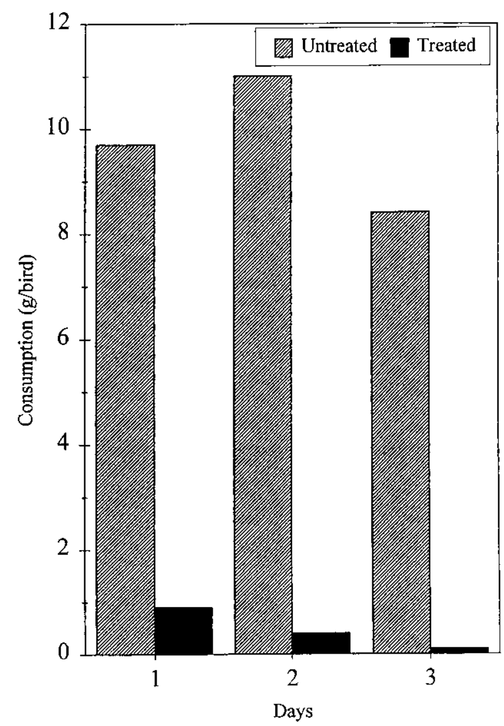

Fig. 2. Red-winged blackbird consumption of 2% Flight Control[R] treated rice seed in a 1-choice test.

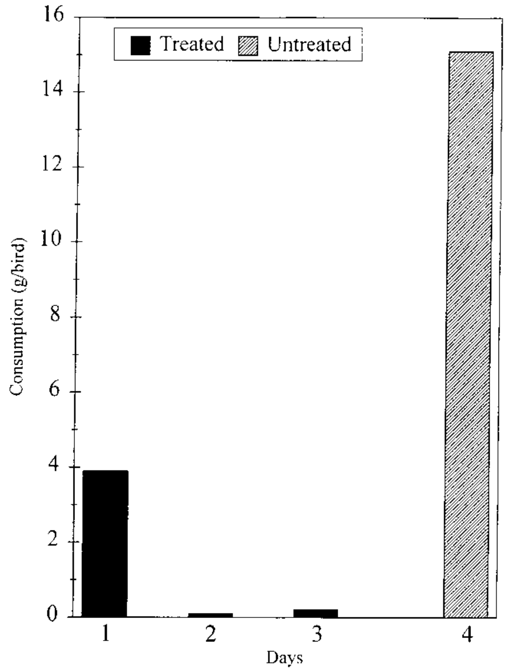

Fig. 3. Red-winged blackbird consumption of 2% Flight Control[R] treated rice seed in a no-choice test.

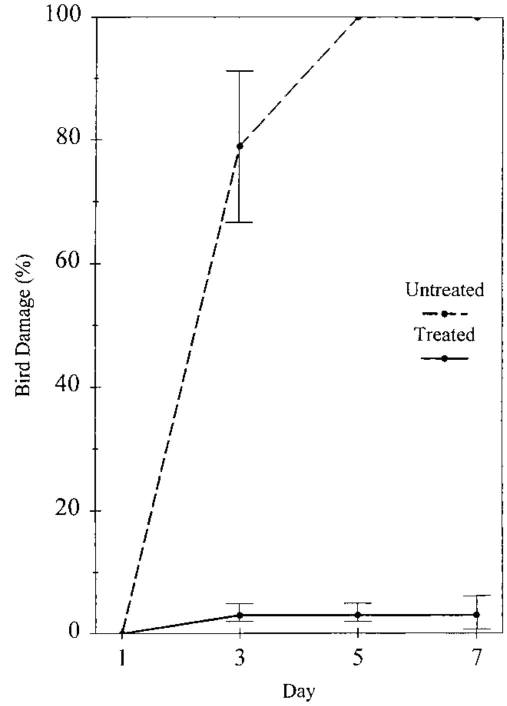

Fig. 4. Blackbird damage to newly planted rice seed treated with 2% Flight Control[R], February 26 to March 10, Vermilion Parish, Louisiana.

In Phase 3, there was a significant difference between treatments ($F = 14.05$; 1,3 df; $P = 0.03$) and a significant interaction between treatments and days ($F = 14.58$; 3,9 df; $P = 0.001$). Blackbirds completely damaged untreated fields by day 5, whereas treated fields received about 4% damage initially and remained at that level to the conclusion of the test (Fig. 4). Bird observations indicated greater blackbird use of untreated fields than treated fields (Table 1). Untreated fields sustained constant bird pressure until fields were completely damaged. In contrast, bird numbers on treated fields were relatively high on day 1 but decreased with time. Birds were still observed in adjacent areas. Red-winged blackbirds constituted 88%, boat-tail grackles 7%, and brown-headed cowbirds 5% of all birds observed. Peak numbers of blackbirds feeding in test fields ranged from 91 to 12,154.

4. Discussion

In cage and field tests, 2% Flight Control[R] effectively repelled blackbirds from consuming treated rice seed. However, rice seed soaked in a 0.13% aqueous solution of Flight Control[R] showed no bird repellency. The lack of this treatment's repellency was probably due to low concentrations of Flight Control[R] ($<0.13\%$ a.i.) on treated seed. We surmise that the soaking solution was not absorbed into the rice seed since about 60–80% of the solution remained after 24 h or that the formulation did not stay suspended.

The mechanism of repellency for Flight Control[R] is unknown but under investigation. Our preliminary observations indicate that ingestion may cause a slight sickness. However, there was no observed mortality in cage or field tests. US Environmental Protection Agency (EPA) data suggests that Flight Control[R] poses no toxicological risk to birds and mammals (EPA, 1998). The lethal dose$_{50}$ (LD$_{50}$) is > 3000 mg/kg for bobwhite quail (*Colinus virginianus*) and > 5000 mg/kg for rats (*rattus norvegicus*) and rabbits (*Oryctolagus cuniculus*). Our cage and field tests indicate that birds experiencing Flight Control[R] avoid consuming it on repeated encounters. Bird observations indicated that there could be site avoidance since birds still remain in adjacent fields.

At a 2% seed treatment rate, about 2.64 kg of Flight Control[R] would be required to treat 136 kg of rice seed. Most rice growers would use a seed treatment if effective and the cost was less than $24.00/ha (D. Hardee, 1999 pers commun.). Since the compound is not yet registered for use on rice seed, the company has not set a price.

The field test produced promising results, however we suggest that Flight Control[R] be evaluated in a large block of rice fields (e.g. > 500 ha) that have a history of blackbird damage to determine if the product remains effective when all rice seed is treated within the block. This could be accomplished under an EPA Experimental Use Permit or an EPA Section 18 Emergency Use Permit since the compound is registered for other uses, i.e. goose repellent on turf. In addition, Flight Control[R], has the potential to be registered as a bird repellent for other crops such as lettuce, tomatoes, cherries, blueberries, and grapes.

Table 1
Blackbird numbers observed on rice fileds planted with 2% Flight Control[R] treated rice and on untreated fields from February 26 to March 10, Vermilion Parish, Louisiana

Field	Treatment	Bird numbers						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1	Untreated	2131	2249	5000	4650	[a]		
2	Untreated	12,154	4992	[a]				
3	Treated	91	32	13	0	0	0	0
4	Treated	2760	180	1200	125	60	0	0
5	Treated	2112	1980	160	120	150	180	0

[a] Planted rice seed completely consumed.

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